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(54) **Process for the preparation of thermoweldable polyolefinic films**

(57) Non-fibrillating thermo-weldable films are made from two layers of the same polyolefinic material, following a seqeunce of operations essentially comprising the extrusion of a base film, cooling and longitudinally stretching it under defined conditions, extruding a relatively thin coating of the same polyolefinic material onto the base film and then transversely stretching the composite film under defined conditions. Typically, an extruded film of isotactic polypropylene is cooled to 40°C., stretched 1:5. coated at a base/coat ratio of 8:1 and stretched transversely 1:8. The polyolefinic material should be a crystalline alpha-olefine polymer or copolymer or a mixture of such.

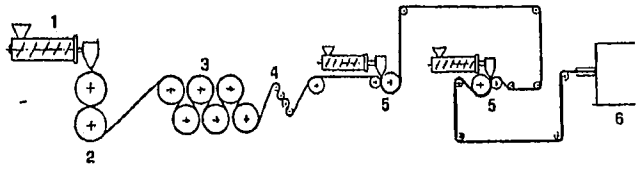

Fig. 1

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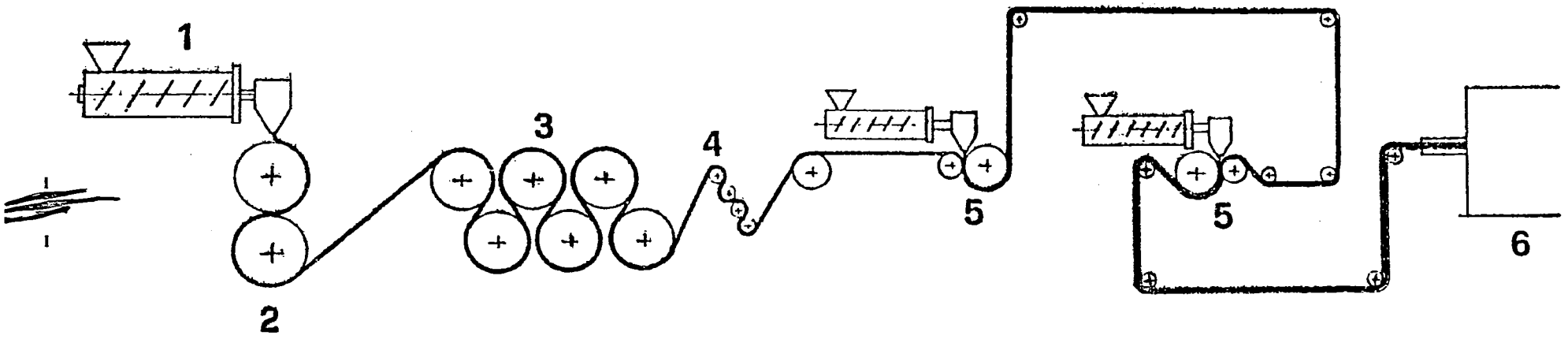

Fig. 1

SPECIFICATION

Process for the preparation of thermoweldable polyolefinic films

The present invention concerns a method for the preparation of thermoweldable, non-fibrilling polyolefine films obtained from a single type of olefinic polymer or copolymer or from mixtures thereof, by the combination of a plurality of successive extrusions and suitable drawing operations.

It is an object of the invention to provide, in a convenient manner, films suitable for the manufacture of containers, covers, small bags, vessels and in general manufactured articles intended for the packaging industry.

As is known, materials intended for packaging should possess a combination of characteristics, both mechanical as well as aesthetic, and in particular impermeability to gases and vapours, of thermoweldability, transparency and brightness and many other characteristics that are difficult to establish simultaneously in films obtained from a single type of polymer. Thus, recourse is made to the use of laminated sheets and coated films obtained by combining polymers of different types.

There are also known and described in various of our patents, laminated and bonded films comprising polyolefinic films and films of other theroplastic polymers or metal foils, in particular of aluminium.

There are also known bonded sheets obtained from non-stretched polyolefinic films and from films of other thermoplastic polymers which are successively stretched, and also films obtained by the extrusion of olefinic polymers onto films of other thermoplastic polymers.

It has now been found that it is possible to obtain thermoweldable and non-fibrilling polyolefinic films by a process which involves extruding on a polyolefine base film a polyolefine composition which is the same as that of the base film and effecting certain suitable stretch operations.

Thus, the process of the invention permits the use of the same polymer composition both for the preparation of the base film and for its coating.

The invention consists in a process for the preparation of thermoweldable and non-fibrilling polyolefinic films which comprises:

(a) preparing a mono-oriented base film by extrusion of a crystalline alpha-olefine polymer or copolymer or of a mixture thereof, cooling the film at 10°C - 70°C and subsequently longitudinally stretching it at 110°C - 150°C with a stretch ratio in the range 1 : 4 to 1 : 7;

(b) extruding, onto one or both faces of the base film, a coating of the same polymer or copolymer or mixture used in the preparation of the base film, so that the thickness of the coating layer is from 1/6 to 1/10 of the thickness of the base film; and

(c) cross-stretching the coated film at a temperature of 120°c to 160°C, using a stretch ratio in the range 1 : 6 to 1 : 10.

The polymers or copolymers or mixtures thereof suitable for use in the process of this invention both for the preparation of the base film and for its coating, are the crystalline polymers or copolymers of alpha-olefines, these generally being prepared with stereospecific catalysts. In particular, polypropylene having macro-molecules which are prevailingly isotactic, and crystalline propylene-ethylene copolymers prevailingly containing propylene units, both of the block as well as of the random type, as well as polyethylene/polypropylene, polyethylene/crystalline propylene-ethylene copolymer, polypropylene/crystalline propylene-ethylene copolymer mixtures may be used.

The polymers and polymeric mixtures may be compounded with dulling agents, stabilizers, lubricants, fillers, and/or organic and inorganic pigments.

Preferably there are used polymers or polymeric mixtures with a melt index in the range 0.1 to 30.

The polyolefinic films obtainable by the process of this invention show good characteristics of thermoweldability, and good mechanical and aesthetic characteristics; they are non-fibrilling and display good resistance to sticking to the welding bars of automatic or semi-automatic machines used for the manufacture of containers, envelopes, small bags, vessels and in general articles intended for the packaging industry.

The accompanying drawing shows in diagramatic form an example of apparatus suitable for carrying out the process of this invention.

The drawing depicts an extruder (1) for the extrusion of the base film, a cooling unit (2), a pre-heating unit (3), a longitudinal stretching unit (4), the extrusion devices (5) for applying the olefine polymer on one or both faces of the base film, and the transverse or cross stretching unit (6).

The measurement of the adhesion of the film to welding bars was made by measuring with an Instron dynamometer the force per surface unit (g/cm^2) necessary for the detachment, from the welding elements, of a specimen connected to the dynamometer and subjected to welding under conditions similar to those of packaging machines normally used (temperatures between 130°C and 150°C, pressure 40 psi, time 1 second).

The fibrillability was evaluated by inspection with an optical microscope, after elongation on the Instron dynamometer.

The resistance of the weld was evaluated at 135°C - 150°C, with an Instron dynamometer, on superimposed and welded samples, under knurled bars, with a Sentinel type welder, for 1 second, under a pressure of 40 psi.

The following examples illustrate how the invention may be carried into effect without limiting the wider

aspects thereof.

EXAMPLE 1

A thermoweldable and not fibrilling polypropylene film was prepared by film extrusion of a crystalline polypropylene having prevailingly isotactic macromolecules, having a melt-index of 1, a residue from the heptane extraction of 97.2%, and an ash residue of 100 ppm, prepared by stereospecific polymerization of propylene. The precedure is schematically represented in the accompanying drawing.

The production of the film is achieved by the following successive operations:

(a) preparation of the unstretched film by extrusion of the polypropylene;
(b) cooling down on rollers, to 40°C;
(c) longitudinal stretching, at 140°C, with a stretch ratio of 1 : 5;
(d) extrusion of polypropylene having the same characteristics as the base film, onto the mono-stretched film using a base film/coating film ratio of 8 : 1;
(e) transverse stretching at 155°C, at a stretch ratio of 1 : 8;
(f) winding up.

The coated film thus obtained had the following characteristics:

- thickness of coating (in microns)	3
- breaking load (kg/sq cm) transverse	2,800
longitudinal	1,300
- elongation (%) transverse	45
longitudinal	180
- adhesion (scotch-tape test) (%)	100
- blocking at 43°C (ASTM D-1146/53)	200
- transparency (ASTM D-1003/59T)	2
- glidability (static friction coefficient TMI)	0.5
- resistance of weld (g/cm) at 145°C	70
at 150°C	250
- fibrillability	none
- adhesion to welding bars at 130°C	0
at 140°C	0
at 150°C	0

EXAMPLE 2

There was prepared a thermoweldable and non-fibrilling polypropylene film, by film extruding a crystalline polypropyline with prevailingly isotactic macromolecules having a melt-index of 2, a residue from the heptane extraction of 97.2%, and an ash residue of 100 ppm, prepared by stereospecific polymerization of propylene, the film being made by using the device schematically illustrated in the accompanying drawing.

The preparation of the film was achieved by the following successive operations:

(a) preparation of a non-stretched film by extrusion of the polypropylene;
(b) cooling on rollers, at 40°C;
(c) stretching in a longitudinal direction at 140°C, with a stretch ratio of 1 : 5;
(d) extrusion of polypropylene having the same characteristics as the base film, onto the mono-stretched film, using a base film/coating film ratio of 8 : 1;
(e) transverse stretching, at 155°C, at a stretch ratio of 1 : 8;
(f) winding up.

The so-obtained coated film had the following characteristics:

- thickness of coating (in microns)	3
- breaking load (kg/sq cm) transverse	2,800
longitudinal	1,300
- elongation (%) transverse	45
longitudinal	180
- adhesion (scotch-tape test) (%)	100
- blocking at 43°C (ASTM D-1146/53)	200
- transparency (ASTM D-1003/59T)	2
- glidability (coefficient of static friction TMI)	0.5
- resistance of weld (g/cm) at 145°C	70
at 150°C	250
- fibrillability	none
- adhesion to welding bars at 130°C	0
at 140°C	0
at 150°C	0

EXAMPLE 3

There was prepared a thermoweldable and non-fibrilling polypropylene film, by film-extruding a crystalline polypropylene with prevailingly isotactic macromolecules, having a melt-index of 10, a residue from heptane extraction of 95%, and an ash residue of 100 ppm, prepared by stereospecific polymerization of propylene and by using the device schematically illustrated in the accompanying drawing.

The preparation of the film was achieved by the following successive operations:

(a) preparation of an unstretched film by extrusion of polypropylene;
(b) cooling on rollers at 40°C;
(c) longitudinal stretching, at 140°C, at a stretch ratio of 1 : 5;
(d) extrusion of polypropylene, of the same characteristics of that of the base film, onto the mono-stretched film, using the base film/coating film ratio of 8 : 1;
(e) transverse stretching at 155°C, at a stretch ratio of 1 : 8;
(f) winding up.

The so-obtained coated film had the following characteristics:

- thickness of the coating (microns)	3
- breaking load (kg/sq cm) transverse	2,600
longitudinal	1,200
- elongation (%) transverse	50
longitudinal	190
- adhesion (scotch-tape test) (%)	100
- blocking at 43°C (ASTM D-1146/53)	200
- transparency (ASTM D-1003/59T)	2
- glidability (static friction coefficient TMI)	0.5
- resistance of weld (g/cm) at 140°C	50
at 145°C	100
at 150°C	250
- fibrillability	none
- adhesion to welding bars: at 130°C	0
at 140°C	0
at 150°C	0

EXAMPLE 4

A thermoweldable and non-fibrilling polypropylene film was prepared by film-extruding a crystalline polypropylene with prevailingly isotactic macromolecules, having a melt-index of 20, a residue from heptane extraction of 90%, an ash residue of 100 ppm, prepared by stereospecific polymerization of propylene, the film having been made by using the device schematically illustrated in the accompanying drawing.

The preparation of the film was achieved by means of the following successive operations:

(a) preparation of an unstretched polypropylene film by extrusion;
(b) cooling on rollers at 40°C;
(c) longitudinal stretching, at 140°C, at a stretch ratio of 1 : 5;
(d) extrusion of polypropylene, of the same characteristics as that of the base film, onto the mono-stretched film, using a base film/coating film ratio of 8 : 1;
(e) transverse stretching at 155°C, at a stretch ratio of 1 : 8;
(f) winding up.

The so-obtained coated film had the following characteristics:

- thickness of the coating (in microns)	3
- breaking load (kg/sq cm) transverse	2,600
longitudinal	1,200
- elongation (%) transverse	50
longitudinal	190
- adhesion (scotch-tape test) (%)	100
- blocking at 43°C (ASTM D-1146/53)	200
- transparency (ASTM D-1103/59T)	2
- glidability (static friction coefficient TMI)	0.5
- resistance of weld (g/cm) at 140°C	50
at 145°C	250
at 150°C	300
- fibrillability	none
- adhesion to welding bars: 1t 130°C	0
at 140°C	0
at 150°C	0

EXAMPLE 5

A thermoweldable and non-fibrilling polyolefine film was prepared by film-extruding a random propylene-ethylene copolymer, having a melt-index of 8; an ash residue of 78 ppm, and an ethylene content of 2.7%, prepared by copolymerization of the propylene/ethylene by means of a stereospecific catalyst, the film having been made by using the device schematically illustrated in the accompanying drawing.

The preparation of the film was achieved by means of the following successive operations:

(a) preparation of the unstretched film by extrusion of the copolymer;
(b) cooling on rollers, at 40°C;
(c) longitudinal stretching, at 125°C, with a stretch ratio of 1 : 5;
(d) extrusion of a copolymer having the same characteristics of that of the base film, onto the mono-stretched film, at a base film/coating film ratio of 8 : 1;
(e) transverse stretching, at 145°C, at a stretch ratio of 1 : 8;
(f) winding up.

The so-obtained coated film had the following characteristics:

- thickness of the coating (microns)	3
- breaking load (kg/sq cm) transverse	2,300
longitudinal	1,000
- elongation (%) transverse	50
longitudinal	210
- adhesion (scotch-tape test) (%)	100
- blocking at 43°C (ASTM D-1146/53)	250
- transparency (ASTM D-1003/59T)	4
- glidability (static friction coefficient TMI)	0.5
- resistance of weld (g/cm) at 135°C	200
at 140°C	300
at 145°C	300
at 150°C	300
- fibrillability	none
- adhesion to welding bars: at 130°C	0
at 140°C	0

CLAIMS

1. A process for the preparation of thermoweldable, non-fibrilling polyolefine films which comprises:

(a) preparing a mono-oriented base film by extruding a crystalline alpha-olefine polymer or copolymer or a mixture thereof, cooling the film at 10°C - 70°C, and subsequently longitudinally stretching it at 110°C - 150°C with a stretch ratio in the range 1 : 4 to 1 : 7;

(b) extruding, onto one or both faces of the base film, a coating of the same polymer or copolymer or mixture used in the preparation of the base film, so that the thickness of the coating is from 1/6 to 1/10 of the thickness of the base film; and

(c) cross-stretching the coating film at a temperature 120°C to 160°C, using a stretch ratio in the range 1 : 6 to 1 : 10.

2. A process according to claim 1, in which for the preparation of the base film and for coating the same there is used a polymeric material selected from: isotactic polypropylene, propylene-ethylene crystalline copolymers with a predominant content of propylene, of the block copolymer or the random copolymer type, polyethylene-crystalline polypropylene mixtures, polyethylene/crystalline propylene-ethylene copolymers and polypropylene/crystaline propylene-copolymer mixtures.

3. A process according claim 1 or 2 in which the polymeric material used has a melt-index of 0.1 to 30.

4. A process according to claim 1, substantially as described in any of the foregoing examples.

5. Thermoweldable, non-fibrilling polyolefine films when prepared by a process as set forth in any of the foregoing claims.

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